Mathematics Toolkit: Grade 7 Objective 2.C.1.c

Standard 2.0 Knowledge of Geometry

Topic C. Representation of Geometric Figures

Indicator 1. Represent plane geometric figures

Objective c. Construct geometric figures using a variety of construction tools

Assessment Limits:

Construct a perpendicular bisector to a given line segment or a bisector of a given angle

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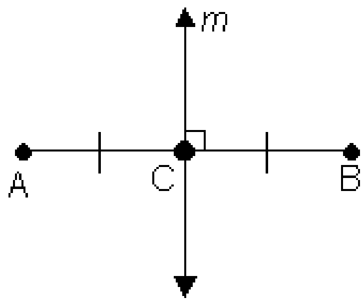
Clarification

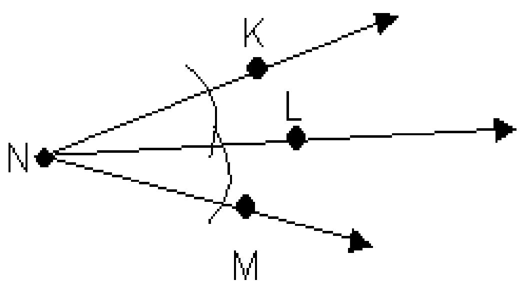
Mathematics Grade 7 Objective 2.C.1.c Assessment Limit 1

A perpendicular bisector is a line that intersects a line segment at the midpoint of the segment and forms 90° angles at the point of intersection.



Line *m* is the perpendicular bisector of $\overline{AB}$ because C is the midpoint of $\overline{AB}$ and the four angles at the intersection of line *m* and $\overline{AB}$ are 90°.

An angle bisector is a ray, line segment or line that passes through the vertex of an angle and separates the angle into two congruent angles.



$\overline{NL}$ is the angle bisector of $\angle KNM$ because $\angle KNL$ is congruent to $\angle LNM$.

Students need to understand the difference between *draw* and *construct*. When students draw or sketch a geometric figure, they use rulers and protractors to measure and create the figures. However, for this indicator, students will construct geometric figures, using compass and straightedge, patty paper, or Miras™. A compass is an instrument used to draw circles and arcs and to duplicate lengths accurately. A straightedge is similar to a ruler but is not used to measure; it is only used to draw a straight line. Patty paper (the name comes from its origin, the paper that is used to separate beef patties) is a square of tracing paper that can be folded and drawn on to demonstrate geometric relationships and duplicate geometric figures. A Mira™ is a transparent and reflective tool that can be used to construct geometric figures through proven geometric relationships.

There are several ways that each of these geometric relationships can be modeled. Which way is used in the classroom is determined by the teacher, the available resources, and the needs of the students. It is not expected that students know all of the methods on how to construct perpendicular or angle bisectors. It is to the students' advantage that they be given the opportunity to choose the method most comfortable for them in classroom instruction. The tools available to students on the assessment will be the compass and straightedge.

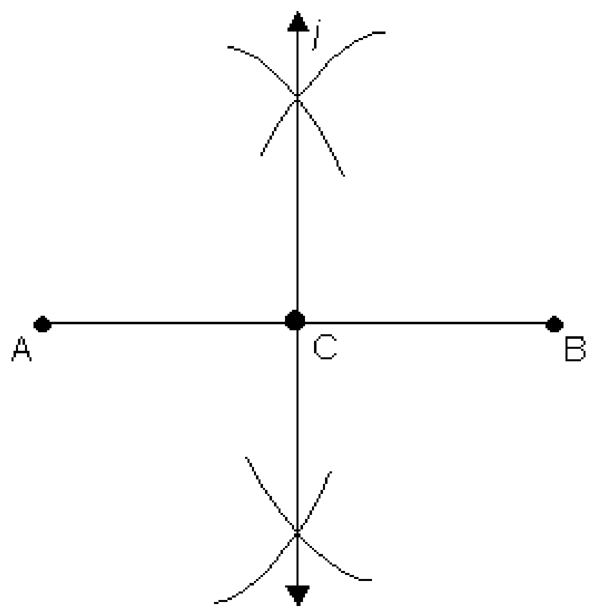
Classroom Example 1

Perpendicular Bisector

Steps for students to construct a perpendicular bisector using compass and straightedge:

1. Draw a line segment on your paper. Label the endpoints A and B.
2. Place the compass point (stable end) of the compass at point A. Open the compass so that the length between the ends of the compass is more than half the length of the line segment. Create one small arc above the line segment and one small arc below the line segment.
3. Without adjusting the compass, move the compass point of the compass to point B and make one small arc above the line segment and one small arc below the line segment.
4. The pair of arcs above the line segment and the pair of arcs below the line segment must intersect. If they do not, open the compass wider so that the arcs will intersect. Complete steps 1, 2, and 3 again.
5. The two intersecting arcs (one above the line segment and one below the line segment) indicate two points that are the same distance from the endpoints of the line segment.
6. Using a straightedge, connect the two points of intersection. Label this line *j*. Label the intersection of line j with line segment AB as point C.

Look at the figure below.



What is the relationship between $\overline{AB}$ and line j?

Answer: The line segment and the line appear to be perpendicular because the angles formed by them measure approximately 90°

What is the relationship between $\overline{AC}$ and $\overline{BC}$?

Answer: $\overline{AC}$ and $\overline{BC}$ appear to be congruent segments because they measure approximately the same length.

Point C is the _________________ of $\overline{AB}$.

Answer: midpoint

Select a point on line j. Label this point X. What is the relationship between $\overline{AX}$ and $\overline{BX}$?

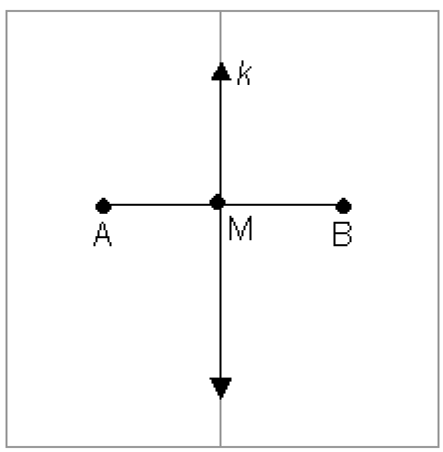
Answer: $\overline{AX}$ and $\overline{BX}$ appear to be congruent because they measure approximately the same length.

Classroom Example 2

Steps for students to construct a perpendicular bisector using patty paper:

1. Draw a line segment on your patty paper. Label the line segment $\overline{AB}$.
2. Fold the patty paper so that points A and B, the two end points of the segment you drew on the patty paper, coincide with each other. Crease the paper along the fold.
3. Open the patty paper and draw a line on the crease. Label this line *k*. Label the intersection of line *k* with $\overline{AB}$ as point M.

Look at the figure below.



What is the relationship of line *k* to $\overline{AB}$?

Answer: The line segment and the line appear to be perpendicular because the angles formed by them measure approximately 90°

What is the relationship between $\overline{AM}$ and $\overline{BM}$?

Answer: $\overline{AM}$ and $\overline{BM}$ appear to be congruent segments because they measure approximately the same length.

Point M is the _________________ of $\overline{AB}$.

Answer: midpoint

Select a point on line *k*. Label this point X. What is the relationship between $\overline{AX}$ and $\overline{BX}$?

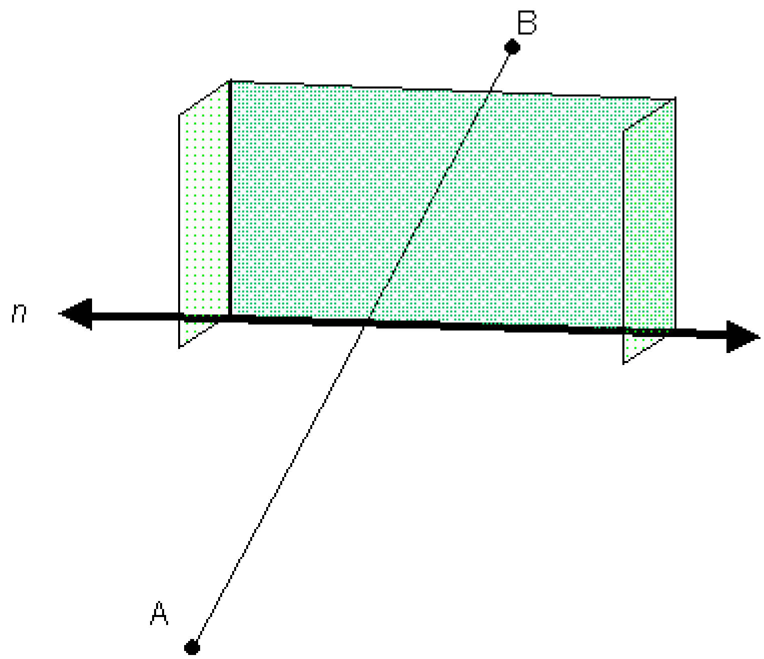
Answer: $\overline{AX}$ and $\overline{BX}$ appear to be congruent because they measure approximately the same length.

Classroom Example 3

Steps for students to construct a perpendicular bisector using Miras™:

1. Draw a line segment on your paper. Label the endpoints A and B.
2. Place a Mira™ on your paper (beveled edge toward you) across $\overline{AB}$ so that the reflection of point A rests on point B.
3. Using the beveled (slanted) edge of the Mira™ as a straightedge, draw the line that the Mira™ has created. Label this line *n*.

Look at the figure below.



What is the relationship of line *n* to line segment $\overline{AB}$?

Answer: Line *n* is the perpendicular bisector of line segment $\overline{AB}$

Classroom Example 4

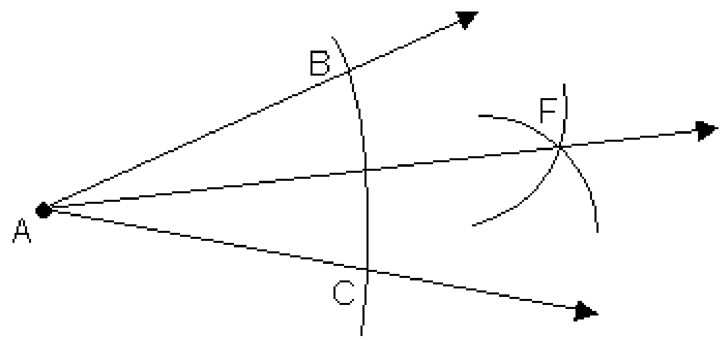
<u>Angle Bisector</u>

Steps for students to construct an angle bisector using compass and straightedge:

1. Draw an angle on your paper. Label the vertex of the angle point A.
2. Place your compass point at A and draw an arc that crosses through both rays of the angle. Label the intersection points of the arc with the sides of the angle as point B and point C.

3. Place your compass point first at B and then at C. Using a radius greater than half the distance from B to C, draw arcs that intersect in the interior of $\angle A$. Label the intersection of the two arcs as point F. Draw $\overrightarrow{AF}$.

Look at the figure below.



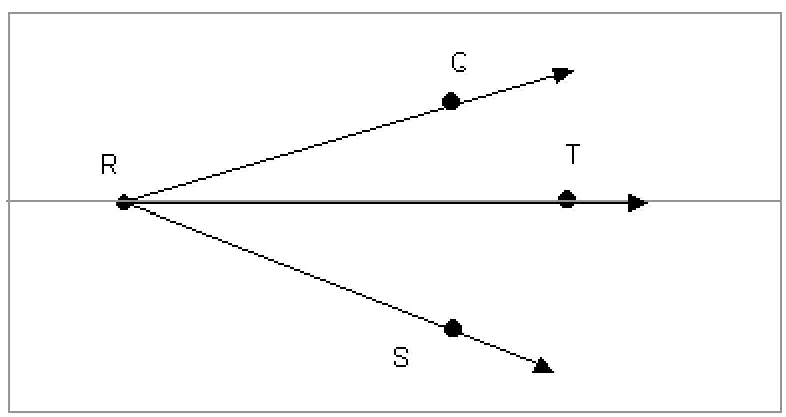
What is the relationship between $\angle CAF$ and $\angle BAF$?

Answer: The angles are congruent.

Classroom Example 5

Steps for students to construct an angle bisector using patty paper:

1. Draw an angle on a sheet of patty paper. Label this angle $\angle QRS$.
2. Fold your patty paper so that the two sides of the angle, $\overrightarrow{RQ}$ and $\overrightarrow{RS}$, coincide. Crease the paper along the fold.
3. Unfold your patty paper. Select a point on the interior of $\angle QRS$ that lies on the crease. Label this point T. Draw $\overrightarrow{RT}$.



What is the relationship between $\angle QRT$ and $\angle SRT$?

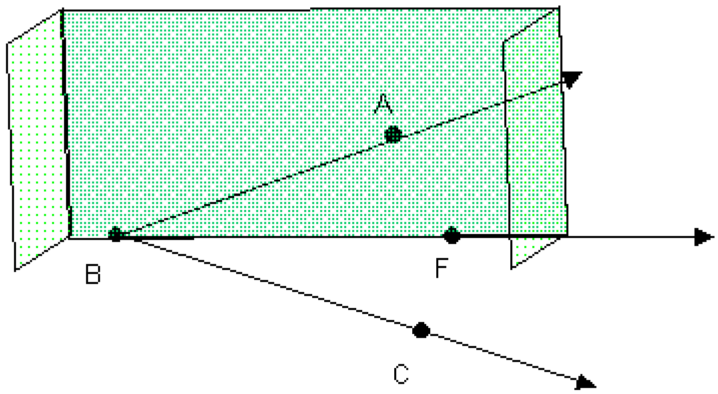
Answer: The angles are congruent.

Classroom Example 6

Steps for students to construct an angle bisector using Miras™:

1. Draw an angle on your paper. Label the angle $\angle ABC$.
2. Place the Mira™ on your paper so that the vertex of the angle coincides with the beveled edge of the Mira™ Place the beveled edge toward you.
3. Position the Mira™ so that $\overrightarrow{BA}$ coincides with $\overrightarrow{BC}$.
4. Using the beveled edge of the Mira™ as a straightedge, draw the ray that has B as its endpoint and that passes through the interior of $\angle ABC$. Label the $\overrightarrow{BF}$.

Look at the figure below.



What is the relationship between $\angle CBF$ and $\angle ABF$?

Answer: The angles are congruent.

Note: Some construction techniques adapted from High School Assessment Core Learning Goal 2 Geometry Instructional Activities, developed in 2003 by the Maryland State Department of Education, accessible at http://www.mdk12.org/instruction/curriculum/hsa/geometry/clg.html